

# Practitioner manual for teachers and educators: supporting practitioner research



INQUIRE

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### The following institutions are partners in the INQUIRE project:

- University of Innsbruck, Austria
- Royal Botanic Gardens, Kew, UK
- King's College London, UK
- Museo delle Scienze, Trento, Italy
- University of Sofia, Bulgaria
- Agencia Estatal Consejo Superior de Investigaciones Cientificas, Spain
- University of Bremen, Germany
- Jardin Botanique de la Ville de Bordeaux, France
- National Botanic Garden of Belgium
- Schulbiologisches Zentrum, Hannover, Germany
- Natural History Museum Botanical Garden, Norway
- Coimbra Botanic Garden, Portugal
- Moscow State University Botanical Garden, Russia
- University of Lisbon, Portugal
- Botanischer Garten, Rhododendron - Park, Botanika, Bremen, Germany
- Botanic Gardens Conservation International, UK
- Universidad de Alcala, Spain



## About the INQUIRE Project

INQUIRE was a three year project (2010-2013), within the 'Science in Society' Programme of the European Commission, focusing on inquiry-based science education and involving 17 partners in 11 European countries. The project was generously funded by the European Union under the 7<sup>th</sup> Framework Programme. Fourteen botanic gardens were involved in the project and individually developed and evaluated their own IBSE teacher training course. INQUIRE was coordinated by Innsbruck University Botanic Garden, Austria, with support from Botanic Gardens Conservation International (BGCI), King's College London, UK and the University of Bremen, Germany.

For more information about INQUIRE visit: [www.inquirebotany.org](http://www.inquirebotany.org)



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## The purpose of this manual

INQUIRE is a three year project focusing on Inquiry-Based Science Education (IBSE). Fourteen botanic gardens have developed a 60-hour IBSE teacher training course with support from Botanic Gardens Conservation International (BGCI) and King’s College London, UK. The University of Innsbruck, Austria coordinates the project. INQUIRE courses are training hundreds of teachers to develop their proficiency in IBSE and become reflective practitioners. INQUIRE aims to reinvigorate IBSE within classrooms and Learning Outside the Classroom (LOtC) settings.

The theme of this manual is the structure and running of reflective practice while implementing IBSE courses in classroom and LOtC settings.

This manual focuses on achieving the project’s goals in a reflective way. The manual will introduce a number of key issues and techniques relating to the design, conduct and evaluation of practitioner based inquiry/research. Through using this manual and participating in the INQUIRE course you will be able to think more critically about inquiring into your own practice as a teacher or educator and be able to use what you have learnt in an ongoing way to understand and improve your practice. This approach is called “action research”.

The manual presents practical suggestions, ideas, methods and strategies for reflective research in educational settings. It draws upon examples of action research carried out by teachers/educators and is intended to be a source of practical support while implementing your IBSE course/lessons. The manual provides examples, exercises and further readings to facilitate the practice of reflective action research.

### Aim

To critically examine the concepts and use of action research and reflective practice in enhancing professional practice using IBSE in both formal and informal settings.

### Learning objectives

After studying this manual you should have developed:

#### Knowledge and understanding of

- Concepts and use of action research.
- Reflective practice.
- Methods to help you to become a reflective practitioner.
- Techniques of reflection, data collection (assessment and evaluation).



### Intellectual skills of

- Critically examining literature and research data.
- Problem-finding and problem-solving skills, critical analysis and evaluation.

### Professional practical skills of

- Reflecting on your personal role in education inquiry/action research.
- Working with colleagues through the application of skills and strategies.
- Increased expertise in the use and analysis of educational inquiry techniques.
- Critically analysing and evaluating your own and others' practice.
- Using reflective practice to improve your teaching particularly in relation to using IBSE.

Over the course of the INQUIRE course you will be encouraged to reflect on many things including personal and team aspects of the project. The reflective learning and writing process are ongoing and you should seek to improve over the course. It is important to be honest and objective in your reflective writing.

## What is reflective practice?

A simple definition of reflection can be consciously thinking about and analysing what you are doing and what you have done; thinking about what and how you have learnt. There is a lot of theory behind reflection that can be very complex. Most of the theory relates to seeing reflection as part of the cycle of learning. Initially, learners focus on knowledge, comprehension and application of subject matter. These three levels of learning are the easiest especially if the application is in a limited context, e.g. problems from a text-book. For higher levels of learning (application of knowledge in real world problems) you must be able to analyse, synthesise and evaluate. Reflection is a key part of moving into these higher levels of learning.

The concept of reflective teaching and reflective action originates in Dewey's (1933) work *How We Think*. Reflective action involves a willingness to engage in constant self-appraisal and development. An aim of the INQUIRE project is to instil techniques required for partners to constantly reflect on their practice while conducting IBSE.

According to Pollard (2008) there are 7 key characteristics of reflective practice, reflective teaching:

1. Implies an active concern with aims and consequences, as well as means and technical efficiency.
2. Is applied in a cycle or spiral process, in which teachers monitor, evaluate, and revise their own practice continuously.



3. Requires competence in methods of evidence-based classroom inquiry, to support the progressive development of higher standards of teaching.
4. Requires attitudes of open-mindedness, responsibility and wholeheartedness.
5. Is based on teacher judgement, informed by evidence-based inquiry and insights from other research.
6. Is enhanced through collaboration and dialogue with colleagues.
7. Enables teachers to creatively mediate externally developed frameworks for teaching and learning.

Reflective practice includes journaling and talking about one's instructional practice. However, doing reflective practice is not the same as doing practitioner research.

Within the INQUIRE course, we encourage participants to develop their technical efficiency in relation to IBSE. We encourage you to monitor, evaluate and revise your own practices using data collection (assessment and evaluation) techniques. We also encourage course participants to collaborate, share and discuss with colleagues at work and within the course in order to support your learning and professional development. Opportunities for reflection should occur before, during and after activities (such as sessions on the INQUIRE course, or when you try a new approach on other courses). That way you can take note of your learning starting point, assess your progress through the project and critically evaluate your learning at the end of the activity.

### How does reflection take place? Levels of reflection

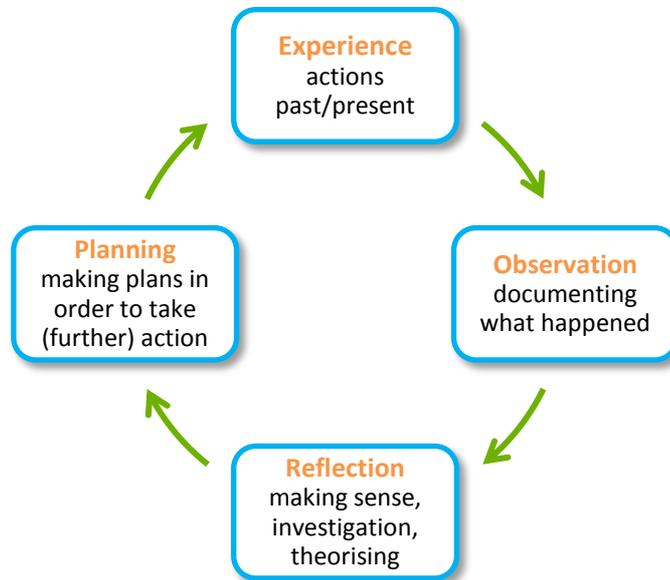
Critical reflection is the process of analysing, reconsidering and questioning experiences within a broad context of issues (e.g. issues related to IBSE, curriculum development, learning theories, politics, culture, or use of outdoor space). Many different approaches can be employed if one wishes to become a critically reflective teacher/educator, including observation of oneself and others, team teaching, and exploring one's view of teaching through writing. We can break down the process of critical reflection into a number of dimensions which address the different activities and levels of reflection.

#### There are three stages in critical reflection

- **The event itself:** the usual starting point is an actual teaching episode, such as a lesson or other teaching/learning event. While the focus of critical reflection is usually the teacher's own teaching, self-reflection can also be stimulated by observation of another person's teaching.
- **Recollection of the event:** the next stage in reflective examination of an experience is an account of what happened, without explanation or evaluation. This examination can be as a written description, a video or audio-recording of an event, or the use of check-lists or coding systems to capture details of the event.



■ **Review and response to the event:** using the recollection the participant returns to the event and reviews it, questions are asked about the experience, making connections with new learning. This process adds depth and breadth to the meanings by asking questions about, and relating meanings to, a spectrum of personal and professional issues.



### Guidelines for reflections

The following questions in the table below may help you in formulating some reflections (taken from [www.audience dialogue.net/journal.html](http://www.audience dialogue.net/journal.html))

<b>Description</b>	What is the stimulus for reflection? (incident, event, theoretical idea) What are you going to reflect on? Describe what happened and set the scene
<b>Feelings</b>	What were your reactions and feelings? What did you think and feel?
<b>Evaluation</b>	What was good and bad about the experience? Make value judgements
<b>Analysis</b>	What sense can you make of the situation? Bring in ideas from outside the experience to help you (literature, what you've learned on the INQUIRE course). What was really going on?
<b>Conclusions (general)</b>	What can be concluded, in a general sense, from these experiences and the analyses you have undertaken?
<b>Conclusions (specific)</b>	What can be concluded about your own specific, unique, personal situation or ways of working?
<b>Personal action plans</b>	What are you going to do differently in this type of situation next time? What steps are you going to take on the basis of what you have learnt?



### Personal reflection

Having enrolled on the INQUIRE course reflect on the core values, beliefs, attitudes and behaviours you would like to foster and develop in your students while you are utilizing outdoor spaces and IBSE in your teaching.

Reflect on your experiences with IBSE in classroom or outdoor spaces – for example...

Q: in a lesson in which you presented your students with opportunities for inquiry, what did you observe about their ability to formulate questions and follow an inquiry strategy? What do you think that they need to get better at this?

Q: What are the advantages and disadvantages to implementing this type of inquiry in my teaching?

### Tools for reflective practice

A reflective approach to teaching involves changes in the way we usually perceive teaching and our role in the process of teaching. Teachers and educators who explore their own teaching through critical reflection develop changes in attitudes and awareness that can benefit their professional growth as teachers/educators, as well as improve the kind of support they provide their students. Teachers and educators engaged in reflective analysis of their own teaching report that it is a valuable tool for self-evaluation and professional growth. The following approaches to critical reflection reflect these processes – many can be used alone or with a supportive colleague.

#### Recording Lessons

Audio or video recording of lessons can also provide a basis for reflection. Many things happen simultaneously in a classroom, and some aspects of a lesson cannot be recalled - recording highlights the advantages and disadvantages of the various approaches undertaken during the lesson. It would be impossible to attempt to recall the proportion of Yes-No Questions to WH-Questions (Who, What, Why, Where, When, etc.) a teacher used during a lesson, many significant classroom events may not have been observed by the teacher, let alone remembered. Recordings of actual lessons can supplement diaries or self-reports (see below). A recording can be achieved simply by locating a digital recorder in a place where it can capture the exchanges that take place during a lesson. Where digital video facilities are available in a school a lesson can be recorded to capture as much of the interaction of the class as possible, both teacher to class and student to student. Once the initial novelty wears off, both students and teacher soon forget the camera, and the class proceeds with minimum disruption.



### Personal reflection

You have just watched a recording of a lesson where you notice that the students were reluctant to raise any questions. How could you deal with this situation again and encourage curiosity and inquisitiveness?

Take a favourite laboratory or practical activity and modify it to be more inquiry-based. Record notes on the ways students complete the activity and the types of questions they ask. How does this compare with how you taught this activity in the past?

### Written accounts of experiences

Another useful way of engaging in the reflective process is through the use of written personal accounts of experiences such as diaries/journals. Journal/diary writing is a valuable tool for developing critical reflection.

#### The goal of journal/diary writing is

- To provide a record of the significant learning experiences that have taken place.
- To help the participant come into touch and keep in touch with the self-development process that is taking place for them.
- To provide an opportunity to express, in a personal and dynamic way, their self-development.
- To foster a creative interaction with the process that is taking place.

While procedures for diary keeping vary (are you a paper and pen diarist, a tweeter, a contributor to an online forum, or a blogger?), the participant usually keeps a regular account of learning or teaching experiences, recording reflections on what he or she did as well as straightforward descriptions of events, which may be used as a basis for later reflection. The diary serves as a means for interaction between the writer, the facilitator and, sometimes, other participants.

### Keeping a diary/journal

Keep a diary/journal for at least one week, preferably two. Each day set aside 10 minutes to write at the end of the work day (you can use the sentence stems below). At the end of the two weeks, read your journal, looking for significant ideas and themes. This will help you to compile a list of things you might like to investigate which you can translate into research questions (see later sections of the manual).

Stems...

- One thing I would like to change is...*
- The students I work with need...*
- I would like to know...*
- I wonder why...*
- The best learning environment/strategy for students is...*
- My students would do better if...*



### Conversations and observations with colleagues

Peer observation can provide an opportunity for teachers to view each other's teaching in order to expose them to different teaching styles and to provide opportunities for critical reflection on their own teaching. Through conversations with colleagues (or participants on the INQUIRE course) you can probe further into aspects of teaching behaviours, discuss critical incidents and explain/justify aspects of teaching behaviour.

#### Personal reflection - Using Published Research

Reflect on your views of inquiry-based science teaching in light of your reading of the following article (available online) entitled 'Experimental Comparison of Inquiry and Direct Instruction in Science':

<http://www.wmich.edu/way2go/docs/short-paper-version.pdf>

### What is action research?

Action research is research that is carried out in practice, which informs practice – a quest for knowledge focussed on how to improve. It typically is undertaken in a school or LOtC setting and is a reflective process that allows for inquiry and discussion as components of the research. It is often a collaborative activity among colleagues searching for solutions to everyday, real problems experienced in classrooms, or looking for ways to improve instruction and increase student achievement.

The ultimate aim of teacher research is transformation, enabling teachers to develop a better understanding of themselves, their classrooms, and their practice through the act of reflective inquiry.

Action research allows practitioners to address those concerns that are closest to them, ones over which they can exhibit some influence and make change rather than dealing with the theoretical. It involves people working to improve their skills, techniques, and learning how we can do things better. It is about how we can change our instruction to impact students. The process of action research assists educators in assessing needs, documenting the steps of inquiry, analyzing data, and making informed decisions that can lead to desired outcomes. It is practical but it is also systematic and requires the practitioner to justify their claims with evidence and making the claims public.



There are different types of action. A plan of research can involve a single teacher investigating an issue in his or her classroom, a group of teachers working on a common problem, or a team of teachers and others focusing on a school- or district-wide issue.

Teacher research is a form of action research, research designed by practitioners to seek practical solutions to issues and problems in their professional lives. The ultimate goal is change or the improvement of the practice.

Action research can be a worthwhile pursuit for educators for a number of reasons, primarily is simply the desire to know more and to expand upon their existing knowledge.

- Focus on personally relevant issues.
- Form of teacher professional development.
- Collegial interactions.
- Potential to impact school change.
- Reflect on own practice.
- Improve communication.

Educators can investigate what effect their teaching is having on their students, how they could work better with other teachers, or ways of changing the whole school for the better. Conversations can take on a different focus and aim to achieve understanding.

### How do I use action research in my teaching?

- Develop questions based on your own curiosity about your students' learning and your teaching (what is the impact on students of introducing IBSE?).
- Investigate your questions with your students systematically documenting what happens.
- Collect and analyze data from your classes including your own observations and reflections.
- Examine your assumptions and beliefs.
- Articulate your theories.
- Discuss your research with your colleagues (or participants on the INQUIRE course) for support as "critical friends" to validate your findings and interpretations of your data.
- Present findings to others – perhaps add a comment on [www.inquirebotany.org](http://www.inquirebotany.org).
- Talk to your students.
- Give presentations (talk to teachers in your school, go to conferences).
- Write about your research (school-wide publication, garden network publication) and participate in educator research web sites, online forums, and e-mail communications.



### Personal reflection - Using Published Research

Read and reflect on this group of pre-service teachers who reflect on their experiences of learning to implement inquiry techniques in their teaching – how might you research your practice?

Reference: Moore, R. A., Bartlett, A., Garrison L., Hagemo, K., Mullaney, J., Murfitt, A. and Smith, S. (1999): Preservice teachers engaged in reflective classroom research. *The Teacher Educator*, 34(4), pp.259-275.

<http://dx.doi.org/10.1080/08878739909555206>

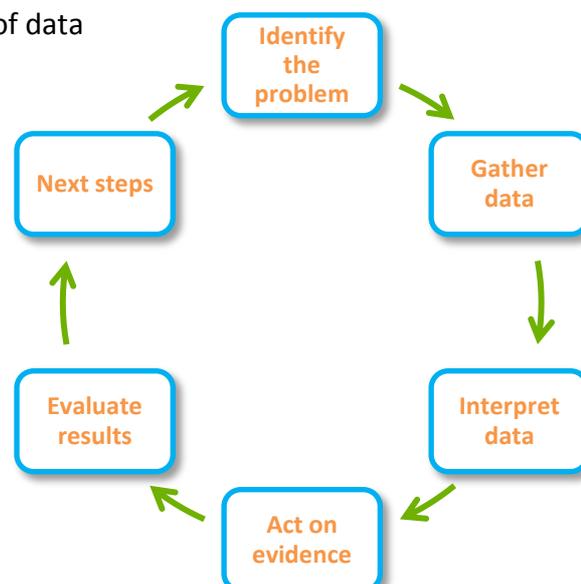
### Value of action research

Teacher-researchers can investigate what it means to understand Inquiry-Based Science Teaching and how both teachers/educators' and pupils' understanding can best be developed through classroom and garden work. Teacher/educator-researchers can investigate questions that interest them in their own classrooms/gardens, develop and experiment with new teaching strategies, try to identify and explain common and contradictory findings, share their experiences and write case studies about their work. This kind of research pays closer attention to details and practicalities of the process of teaching and learning and can probe the difference between stated aims and actual practice. Teacher/educator-researchers can describe and theorise about their practice in order to gain insights and develop their professional knowledge.

### Steps in Action Research

Within all the definitions of action research, there five phases of inquiry:

- Identification of problem area/question
- Collection and organization of data
- Interpretation of data
- Action based on data
- Reflection



### 1. Identify a problem area/question

Teachers/educators often have several questions they wish to investigate – these need to be formulated into research questions. It is important to pose a question that is meaningful and do-able in the confines of your daily work: is this something over you have influence over?

### 2. Gather data

The collection of data is an important step in deciding what action needs to be taken. Multiple sources of data are used to better understand the scope of happenings in the classroom or school or garden. There are many vehicles for collection of data, see the section on data collection later in the manual.

Select the data that are most appropriate for what you are interested in changing within your practice. Are the data easy to collect? Are there sources readily available for use? How structured and systematic will the collection be? Organize the data in a way that makes it useful to identify trends and/or themes. Data can be arranged by gender, classroom, level, school, etc.

### 3. Interpret data

Analyze and identify major themes. Depending upon the question, teachers/educators may wish to use classroom data, individual data, or subgroup data. Some of the data are quantifiable and can be analyzed without the use of statistics or expert assistance. Other data, such as opinions, attitudes, or checklists, may be summarized in table form. Data that are not quantifiable can be reviewed, summarised and important elements or themes can be noted.

Action Research is practical. It is so practical that when people first meet the idea they often say: *That's what I do in any case. What's the difference?*

McNiff and Whitehead (2005)  
Action Research for Teachers, p.2.

### 4. Act on evidence

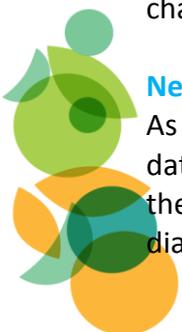
Using the information from the data collection and what you know and have read from current literature, design a plan of action that will allow you to make a change and to study that change. While the new technique is being implemented, continue to document and collect data.

### 5. Evaluate the results

Assess the effects of the “plan” to determine if improvement has occurred. If there is improvement, do the data clearly provide the supporting evidence? If not, what changes can be made to elicit better results?

### Next steps

As a result of the action research project, identify additional questions raised by the data and plan for additional improvements, revisions, and next steps. At each of these stages, your actions, thoughts and evaluations can be recorded in a reflective diary to continually inform the cycle.



### Personal reflection - Using Published Research

Read the example of a action research projects in the article below – what features/steps of teacher inquiry can you recognize? What are the main differences?

References:

1. Mordock, K. and Krasny, M.E. (2001). Participatory Action Research: A Theoretical and Practical Framework for EE. *The Journal of Environmental Education*, 32(3), 15-20.

<http://dx.doi.org/10.1080/00958960109599140#>

2. Roche, M. (2011). Creating a dialogical and critical classroom: reflection and action to improve practice. *Educational Action Research*, 19(3), pp.327-343.

<http://dx.doi.org/10.1080/09650792.2011.600607>

## How do I start? How to implement the cycle

### What are research questions and where do they come from?

For most practitioners the first step is to formulate a plan/design. McNiff and Whithead (2005) call this reflective questioning and the 'Wh-?' questions deal with immediate practical issues: what? who? which? when? where? why? All of these 'Wh-' questions can be turned into a 'how do I...?' that will signal your intent towards improvement. For example:

**What is going on here?**

How do I understand it?

How do I improve it?

How do I investigate it?

**Who will I involve?**

How will I involve them?

**Which issue shall I focus on for my research?**

How do I formulate a research question?

**When will I collect data?**

How do I make time for my research?

**Where will I study?**

How do I find a time and space to reflect?

### Research questions should

- Be a higher-order question, not a yes/no.
- Be stated in common language, avoiding jargon.
- Be concise.
- Be meaningful.
- Not already have an answer.



### Developing a research question

Start with a “free write” activity based on these questions:

- *What do I want to figure out? and why?*
- *What do I want to know about my teaching?*
- *What do I want to know about student learning?*
- *What classroom situation do I want to analyze?*

Share highlights from the free write session and brainstorm with a colleague. A research question can take shape and evolve over time and it is advisable that you recast your questions several ways. Write your question first as a why statement:

- *Why do my students do...*
- *Why do I do...*

Next, recast your question:

- *What happens when...?*
- *How does...?*
- *What is happening when...?*

Settle on a question that you feel comfortable addressing and then brainstorm ways that you can collect data that may address the question you have chosen.

As you begin collecting data, you may discover that it will be necessary to revise your research question to fit the data. You may find yourself asking: *Is there something else more interesting emerging from my data?* Review your research question by asking:

- *What data do I have?*
- *What does the data tell me about my question?*
- *What other questions does my data tell me about?*
- *Is my question more complicated than I had previously thought?*

You may need to revise or even change your question however the research that you are doing is helping you become more aware of what is happening in your classroom.

### Developing research questions - Using Published Research

Read the examples of the research projects in the articles below – what research questions are they addressing?

References:

1. Bodzin, A.M. (2008). Integrating Instructional Technologies in a Local Watershed Investigation With Urban Elementary Learners. *The Journal of Environmental Education*, 39(2), pp.47-58.

<http://dx.doi.org/10.3200/JOEE.39.2.47-58>

2. Dresner, M. (2002). Teachers in the Woods: Monitoring Forest Biodiversity. *The Journal of Environmental Education*, 34(1), pp.26-31.

<http://dx.doi.org/10.1080/00958960209603479>



## Types of data

Data is obviously a very broad term, so we subdivide data for empirical research into two main types:

- **Quantitative data** – which are data in the form of numbers (or measurements).
- **Qualitative data** – which are data not in the form of numbers (most of the time, though not always, this means words).

This leads to two simplifying definitions:

- **Quantitative research** is empirical research where the data are in the form of numbers.
- **Qualitative research** is empirical research where the data are not in the form of numbers.

These simplified definitions are useful for getting started in research, but they do not give the full picture. The term “quantitative research” refers to a whole way of thinking, or an approach, which involves a collection or cluster of methods, as well as data in numerical form. Similarly, qualitative research is a way of thinking, or an approach, that similarly involves a collection or cluster of methods, as well as data in non-numerical or qualitative form. The nature of the data is at the heart of the distinction between quantitative and qualitative research. This manual deals with both qualitative and quantitative approaches to research, and is based on the view that neither approach is better than the other, that both are needed, that both have their strengths and weaknesses, and that they can and should be combined as appropriate.

When both qualitative and quantitative methods are combined it is often in action research design. The fundamental rationale behind mixing methods from quantitative and qualitative research is that we can learn more about our research topic by combining the strengths of qualitative research with the strengths of quantitative research while compensating at the same time for the weaknesses of each method. The following is a list of data that can be used in research.

These techniques may also be considered to be assessment or evaluation strategies that you can use with your students to monitor their learning/progress.



## Data collection techniques

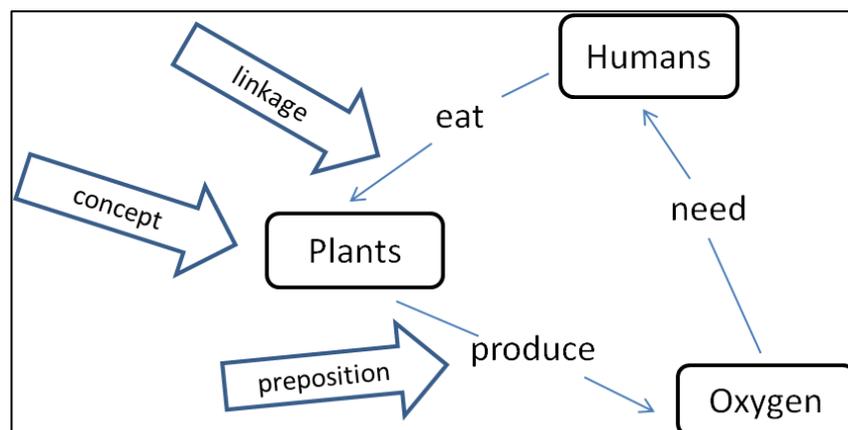
### 1. Concept maps

A concept map is a visual representation of the links between mental concepts. This tool was invented to study changes in students understanding of science concepts in the early 1970s by Joseph Novak and colleagues. Research has shown that concept maps are reliable and valid indicators of conceptual understanding and changes in relevant concepts and propositional structures. The tool has now become a powerful knowledge representation tool useful not only in education but in virtually every sector of human activity (Novak and Cañas, 2006). Not only are concept maps useful tool to assess knowledge development but are supposed to help students learn how to learn meaningfully and cooperatively. The latter occurs when concept maps are built together in small groups because this often serves to correct faulty ideas.

An important function of concept maps in inquiry-based learning is to help make the overall framework of the key concept explicit. This is particularly important for complex topics where students display a fragmentary understanding of a topic and are frequently unable to integrate the components to form a meaningful overview (Kinchin and Hay, 2000). Concept maps are therefore not only helpful to assess students' development but to monitor the effects of inquiry-based science instructions.

#### What does a concept map look like?

Concept maps show the specific label (usually one or two words) for one concept in a bubbles or boxes, with lines showing linkage words that create a meaningful statement or proposition.



Adapted from [www.plantscave.net/modules/b\\_book\\_engl\\_t1\\_m10.pdf](http://www.plantscave.net/modules/b_book_engl_t1_m10.pdf)



## **How to implement concept maps to assess classroom or out of school learning environments**

The use of concept maps for classroom/out of school learning assessment needs to include four steps:

1. In many cases it is helpful for analyzing concept maps later, when the teachers/educator develops a master concept map first. This one is based on the knowledge content he or she expects student to develop in course of the inquiry-based learning activity/unit. This master map can also be provided by another expert in the field e.g. scientist.
2. Students are trained in a concept mapping technique and they develop a level of proficiency necessary to produce a reliable result.
3. Time is placed in to the inquiry-based curriculum to produce concept maps.
4. The teachers/educator selects an adequate scoring technique to analyse the concept maps based on a given research/reflective practice question.

### **How can a concept map be evaluated?**

The concept map evaluation involves an examination of the content and the structure of a concept map. The nature of the analysis may involve qualitative and/or quantitative observations. Assessment tasks may include comparison of the scores from one assessment to another (pre and post assessment). Research has shown that comparing students map with a master map leads to more valid results (McClure et al., 1999).

### ***Quantitative Analysis***

Quantitative analysing techniques can simply focus on counting correct concepts, linkages and/or prepositions appearing in a student's concept map in comparison with the master map. A map score is calculated for each student map. The most reliable but time consuming method is to define a neighbourhood for each concept (one concept and its direct neighbours). The concept neighbourhoods in students' maps are then compared with the congruent concept neighbourhoods in the master map and a similarity score is calculated. Finally all concept scores are added to a map score.

A less time consuming method with good reliability is the rational scoring method adapted from McClure and Bell (1990). Individual maps are scored by evaluating the separate prepositions identified on the map. A preposition is defined as two concepts connected by a labelled arrow indicating the relationship between the concepts. Each preposition is scored from 0-3 in accordance to the correctness of the preposition (the levels of correctness needs to be described in a scoring protocol) in comparison with the master map (McClure et al., 2000).



### **Qualitative Analysis of concept maps**

Maps can be differentiated in terms of their complexity, resilience in accommodating additions, establishment of a context for the key concepts degree of a appreciation of a wider viewpoint and in relationship with a expert view (= master map). Different structures are: “spoke”, “chain” and “net”. Implicit in this classification is the development of increasing integration of a conceptual framework from “spoke” to “net” (Kinchin and Hay, 2000).

#### **Concept Mapping as a Form of Student Assessment and Instruction**

Read the paper outlining how concept maps may be used as a form of student assessment. There are many examples of concept maps – what do you envisage as the main advantages and disadvantages to incorporating this strategy into your teaching?

<http://www.robertabramsconsulting.com/docs/ConceptMapMethodPpr91299.pdf>

## **2. Concept Cartoons**

Concept cartoons are cartoon-style drawings that put forward a range of viewpoints about a science concept or everyday event. Naylor and Keogh (1999) researched, developed and refined their use as a science assessment and teaching tool. This strategy takes account of constructivist views of learning, that is, taking students' ideas into account when planning teaching. By presenting a number of possible alternatives, “cognitive conflict” generates conditions for learning readiness. It also draws on research into common areas of misunderstanding in science. Features of concept cartoons include:

- Presentation of alternative ideas about a concept, including the scientifically acceptable stance.
- The use of visual images.
- Minimal use of written language.
- Contexts that are familiar to children.

Concept cartoons can be used at the beginning or part way through a unit of work, to:

- Gain an indication of the range of students' ideas within the class.
- Identify areas of misconception.
- Stimulate starting points for investigations.
- Offer challenges that may lead to restructuring of ideas.

They can also be used at the end of a unit of work to review learning. More details and examples can be viewed on the concept cartoons website

([www.conceptcartoons.com](http://www.conceptcartoons.com)).



### How the strategy works

- Concept cartoons stimulate students to discuss their ideas, including those that are normally reluctant to do so. This gives teachers access to those ideas. It also gives students access to each other's ideas, which may prompt them to reconsider their own.
- The visual cartoons and minimal written text provide a valid assessment strategy for students with poor literacy skills, reluctant learners, and ESOL students.
- Concept cartoons appear to reduce the risk of fear of giving a "wrong" response.

### How to use concept cartoons

- Present the concept cartoon to individual students, small groups, or the class.
- Ask them to comment on each statement or ask them to indicate which statement they agree with.
- Ask students to give a reason for their choice. This is particularly important for accessing their thinking processes.
- Encourage debate between students with different opinions.
- Follow up discussions with students setting up investigations to explore their ideas.
- Note that for some concept cartoons there may be no one right answer. "It depends on..." may be an appropriate response.

### To generate your own concept cartoon

- Use everyday contexts that students are familiar with. Provide three or four alternative statements for discussion.
- Generally use positive rather than negative statements.
- Refer to research on common alternative conceptions as a source for statements.
- Include the scientifically acceptable viewpoint.
- Some multiple-choice questions are suitable for adapting to a concept cartoon.
- Instead of having faces, just use speech bubbles from the "draw" feature of your word processing programme. This may be more appropriate for older students.

### Limitations

- Teachers need to access research into common alternative ideas to construct their own concept cartoons.
- Cartoon faces or stances that are not carefully chosen can inadvertently provide clues.

#### Thinking about concept cartoons - Using Published Research

Read the article below examining teachers' view of using concept cartoons in teaching—what other sources of data have these researchers used and analysed in their study?

<http://idosi.org/mejsr/mejsr5%282%29/7.pdf>



### 3. Portfolios of evidence

Reflection and assessment are essential for learning. Gillespie et al., (1996 p.487) define portfolio assessment as a purposeful, multidimensional process of collecting evidence that illustrates a student’s accomplishments, efforts, and progress (utilizing a variety of authentic evidence) over time. What is collected, who collects it, how it is collected, who looks at it, how they look at it, and what they do with what they see is all determined first by the purpose for the portfolio.

Portfolios can be used to show growth over time, to show progress towards curriculum standard, to show the journey of learning including process and products over time as well as used to gather quantitative information for the purposes of assessment outside the classroom (e.g. Anson and Brown, 1991; Fritz, 2001; Millman, 1997; Willis, 2000).

The strengths of portfolios lie in the range and comprehensiveness of evidence, variety and flexibility in addressing its purpose (Julius, 2000). Portfolios are used successfully in different ways in different classrooms. Portfolios provide for a range of expression of learning and do so with evidence that can be of considerable technical quality and rigor. From an assessment perspective, portfolios provide at least four potential “values-added” to more traditional means of generating evidence of learning:

- They are extensive over time and therefore reveal growth and development over time.
- They allow for more sustained engagement and therefore permit the examination of sustained effort and deeper performance.
- To the extent that choice is involved in the selection of content (both teacher and most especially student choice), portfolios reveal students’ understandings about and dispositions towards learning.
- They offer the opportunity for students to interact with and reflect upon their own work.

The emphasis in portfolio development could be on two different levels:

- On the process of the portfolio construction ⇨ this is a formative approach, where the emphasis of the professional development effort should centre on the process of development.
- On the portfolio as a product ⇨ this suggests a summative approach, where comparison might be made between the finished portfolio of others.

Meta-cognitive skills are supported and practiced during the development of a portfolio as students reflect on their learning and select work samples, put work samples in the portfolio, and prepare self-assessments that explain the significance of each piece of work.



Portfolio construction involves skills such as awareness of audience, awareness of personal learning needs, understanding of criteria of quality and the manner in which quality is revealed in their work and compilations of it as well as development of skills necessary to complete a task. Portfolios are used to support learning and for assessment purposes, both formative and summative. Portfolio assessment is linked to self-directed learning since the onus is on the learner to demonstrate achievement of the appropriate standard. The portfolio provides a framework into which the learners can put self-selected material providing evidence of their achievements.

### **What can be assessed using portfolios?**

Assessment must be focused on the learning outcomes of the curriculum. The attraction of the portfolio is that it can include evidence of achievement of all the learning outcomes within its structure.

### **How to implement portfolio assessment?**

Portfolio assessment has five stages:

1. Collection of evidence of achievement of learning outcomes
2. Reflection on learning
3. Evaluation of evidence
4. Defence of evidence
5. Assessment decision

### **4. Interviews**

The interview is a widely used means of data collection and is central in most research designs. Interviews are purposeful conversations between the respondents and interviewer/researcher. Interviews are generally seen as an effective way of seeking people's views. How many interviews you plan to carry out is determined in reality, time and resources, but it also depends on the purpose of your interviews. As with all data collection, your design stages should include planning ahead to how the data will be analysed and interpreted to make sure that you have planned in time to review interview data and emerging issues as you go along and not leave it all until the end of your project. It is important that you are eliciting the responses you require for your research; if the interviews are not transcribed or reviewed until they have all been completed you may miss opportunities for clarifying key points as they emerge. The personal nature of interviews can be viewed as both a strength and a limitation.



The main advantages of interviews are that they can provide an opportunity for in-depth conversation with respondents (students, teachers, colleagues), they can yield rich data and are useful for gathering data from students. Questions can be clarified if necessary, which is not possible for example, when using questionnaires. The main disadvantages are that they can be very time

consuming, data is not easy to quantify, if the interview/data was poorly planned and organised, then the data may be difficult to analyse and the interviewer can lead towards bias. Therefore, it is important to spend time planning and testing your questions, to take time to build a rapport with respondents. It may also be worth recording the interview.

#### How to analyse qualitative data

- Gather the data into a clear and readable form
- Sort the data according to your research questions
- Create analytic files/categories
- Categorise/ summarise your data

A first step in analysis is to read, read and read again, the transcripts from the interviews (or to listen to the recordings several times) – you might want to make notes and annotate as you go along. At this point you can begin to make notes about what you have learned from the interview and summarise this. The interview data can be analysed into broad categories/groups/themes to look for trends and reflections on the data. This means labelling segments of texts. You may wish to use mind-mapping to organize these labels into themes. It is important to be systematic and objective as you examine your data. Write up your major points and match collected data to each major point.

#### Developing an interview schedule

Design your own interview schedule (a list of questions or topics to discuss) on a topic of your choice, describing the target group and providing a draft ethics protocol (getting informed consent, being honest, not forcing anyone to take part, giving participants the right to withdraw, protecting them from harm, feeding back the results, maintaining confidentiality).

### 5. Observations

Observational techniques are an important aspect of many action research studies and of case studies. An important question is: what specific contribution can observation make to research in education? What can observational techniques provide that concept maps or interviews can't? The distinctive feature of observational techniques is their ability to record the flow of interaction, i.e. the dynamics of behaviour.



There are a number of observational techniques available: simple check list, a structured observation schedule for classroom research, using videos, still photography, tape recorders, verbatim or selective field notes or memory, or a combination of one or more of these. The difficulty with all these methods is that the problem of what to do with all the data collected. The data are certainly richer and more faithful to the nature of the interaction.

There are a number of issues with conducting observations:

- What to look at.
- How to observe.
- Where and when to look.
- What to record.

Wolcott (1981) proposes four strategies for deciding what to look at and how to look:

- Observations by broad sweep – selectivity and what really matters to you.
- Observations of nothing in particular – wait and see what jumps out.
- Searching for paradoxes.
- Searching for the problem(s) facing the group.

Other key places for observation may include corridors and staff rooms. Recording during observation should be carried out as unobtrusively as possible, ideally noting verbatim speech or at least some key words/phrases that will serve to jog the memory later. It is essential to constantly analyse and interpret data; or it may become so complex, convoluted and confusing that it fails to serve any purpose.

### Observations

Make a case for choosing observation as a data collection technique for your own research project. Consider possible criticisms of your choice. Design your own observation technique for your research topic, describing and discussing the aims of the observation, the nature of the observation (what/who/how/when will you observe?) and the method of recording (e.g. field notes or using a structured observation schedule). You may also need to provide a draft ethics protocol (getting informed consent, being honest, not forcing anyone to take part, giving participants the right to withdraw, protecting them from harm, feeding back the results, maintaining confidentiality).

### Ethical aspects: teacher research

When you conduct research and write about your research you must protect the safety and the rights of your participants (students, teachers, colleagues). It is also important to be honest and tell the truth as you understand it when you report on and discuss your findings.



### At the early planning stage

- Identify where ethical issues may arise in your research.
- Ensure that you have a clear purpose and strategy in mind.

### Before gathering data

- Ensure that you have consent where it is needed (director of education? headteacher? other teachers? school board? parents? children? others?) – this will depend on the regulations for your area.
- Ensure that you have fully explained the purpose of the research and its implications – this will ensure that you receive informed consent.
- Be clear about whether you are promising confidentiality and know what that means – no individual or institution should be identified in any way without their consent.

### Gathering data

- Ensure that participation will be made as easy and pleasant as possible and that the research causes the least possible disruption to the on-going life of the participants and groups.

## Making Teacher Knowledge Public: How to write a case study

Case studies are intensive analysis of an individual unit – such as implementation of inquiry-based science teaching in a botanic garden, or with year 2 science students. They are narratives utilised for dissemination and discussion and may be descriptive or explanatory. They provide a systematic way of looking at events, collecting data, analyzing information, and reporting the results. As a result the teacher/educator/ researcher may gain a sharpened understanding of why the instance happened as it did, and what might become important to look at more extensively in future research. Case studies lend themselves to both generating and testing hypotheses.

A case study report could be structured according to the action research cycle (see diagram earlier in the manual). A sample structure for a case study could include:

### Introduction

- What was the research question?
- Why is this question important to me?
- What was the context of the study?

### Overview of the literature

- What did I learn from my investigation/readings around the topic?



### Research plan

- What was my research plan?
- What data collection methods did I use?

### Results and conclusions

- What did I find out? Summary of the data collected
- Discussion of the conclusions based on the data gathered

### Implications and recommendations

- What have I learned from doing the study?
- How can this information be useful for me or others?
- If I repeated this study, what would I do differently?

#### Published case studies

Read the following article – is this a descriptive or exploratory case study? What have you learned about the structure of a case study report?

Morgan, S.C., Hamilton, S.L., Bentley, M.L. and Myrie, S. (2009). Environmental Education in Botanic Gardens: Exploring Brooklyn Botanic Garden's Project Green Reach. *The Journal of Environmental Education*, 40(4), pp.35-52.

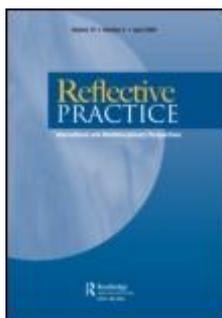
<http://dx.doi.org/10.3200/JOEE.40.4.35-52>

## Examples of research journals that contain practitioner research



### Educational Action Research

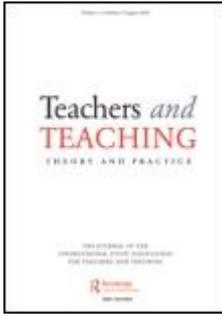
Educational Action Research is a fully refereed international journal concerned with exploring the dialogue between research and practice in educational settings. The considerable increase in interest in action research in recent years has been accompanied by the development of a number of different approaches, for example, to promote reflective practice; professional development; empowerment; understanding of tacit professional knowledge; curriculum development; individual, institutional and community change; and development of democratic management and administration.



### Reflective Practice

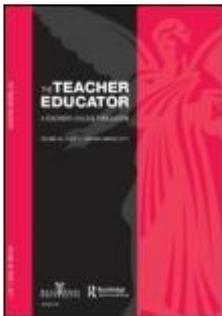
Reflective Practice publishes original, challenging and stimulating work which explores reflection within and on practice, as an individual and collective activity, that concerns personal knowledge and transformation, collective regeneration and political activism, reflection and voice, values, negotiated meaning, identity and community.





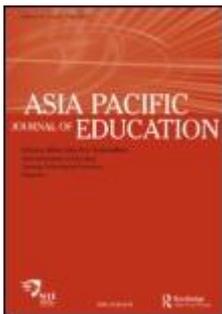
### Teachers and Teaching

Teachers and Teaching: theory and practice provides an international focal point for the publication of research on teachers and teaching, in particular on teacher thinking. It offers a means of communication and dissemination of completed research and research in progress, whilst also providing a forum for debate between researchers. This unique journal draws together qualitative and quantitative research from different countries and cultures which focus on the social, political and historical contexts of teaching as work. It includes theoretical reflections on the connections between theory and practice in teachers' work and other research of professional interest.



### The Teacher Educator

The Teacher Educator is the official journal of the Indiana Association of Teacher Educators. This national peer-reviewed journal is published four times each year. The Teacher Educator is focused on current issues, research, and program innovations that augment teacher preparation and continued professional development for educators. The journal serves as an international forum for stimulating discussion among educators who seek to challenge existing boundaries in the field.



### Asia-Pacific Journal of Education

Asia Pacific Journal of Education focuses on major shifts in educational policy and governance, curriculum and pedagogy, and on the everyday lives and practices of students and teachers in the Asia-Pacific Rim. New empirical and theoretical work, as well as critical and exploratory essays that focus on the impacts of modernity, postcolonialism and globalisation on education systems will be featured.



### Cambridge Journal of Education

Cambridge Journal of Education, an international English language journal, publishes original refereed articles on all aspects of education with a particular emphasis on work that contributes to shared understanding among academic researchers, theorists, practising teachers, policy-makers and educational administrators. Its readers include members of each of these groups – evidence of its success in bringing together those who determine the content, organisation, and practice of education.



### British Educational Research Journal

The British Educational Research Journal is an international peer reviewed medium for the publication of articles of interest to researchers in education and has rapidly become a major focal point for the publication of educational research from throughout the world.



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## Practitioner manual

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